



Explorers Program Retreat

Independent Review Perspective

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IRT Responsibility

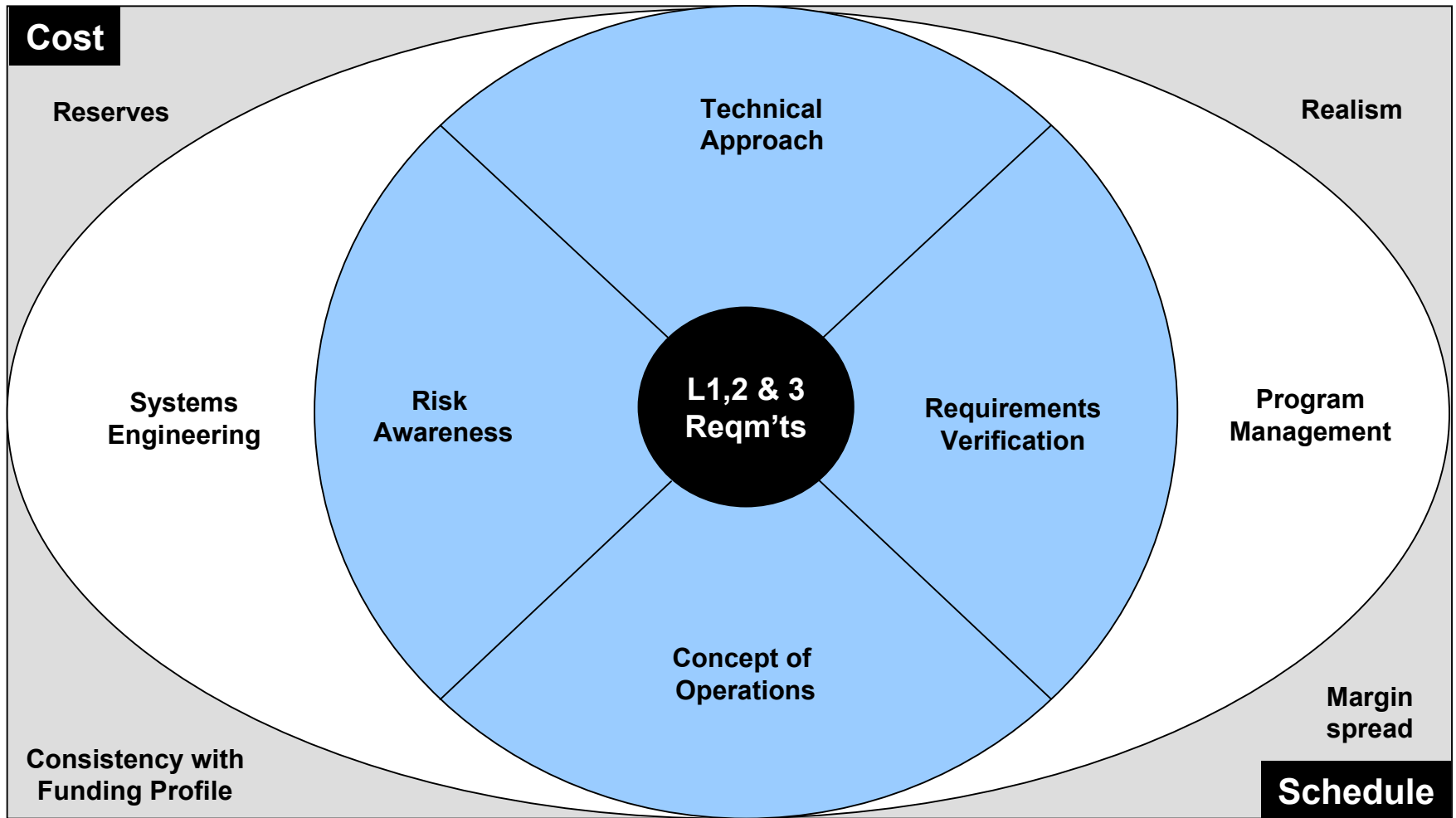
- **Provide Accurate and Objective Answers to NASA's Questions**
- **Help the Project**

Reviewer Guidelines

- **Get up to Speed**
- **Get to know the players**
- **Adjust to the landscape of the program**
- **Stay Focused on the Objectives of the Review**
- **Keep an open mind**
- **Write Recommendations versus Actions**
- **Supply Relevant Lessons Learned**



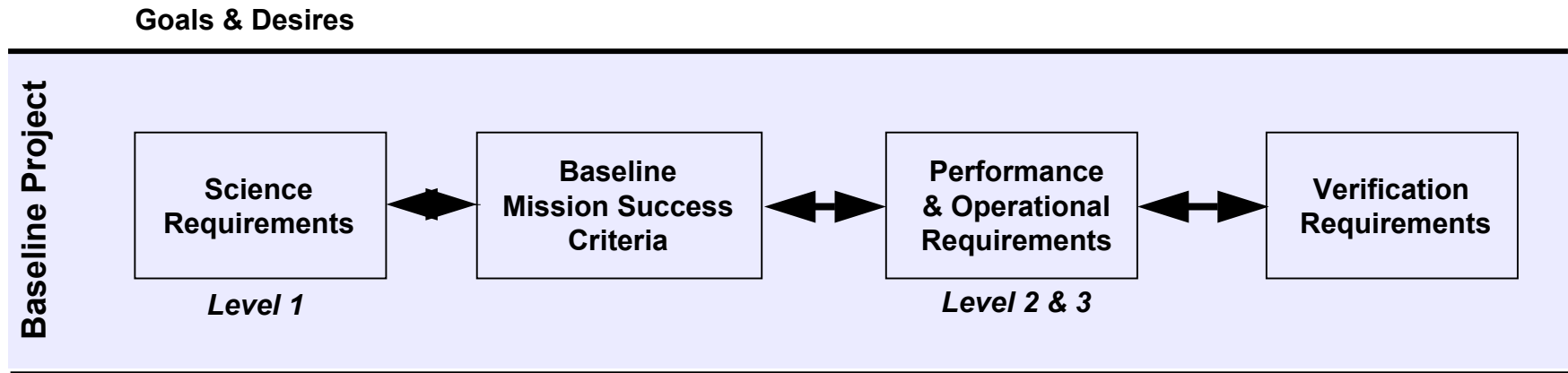
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Requirements



Descope & Recovery Options

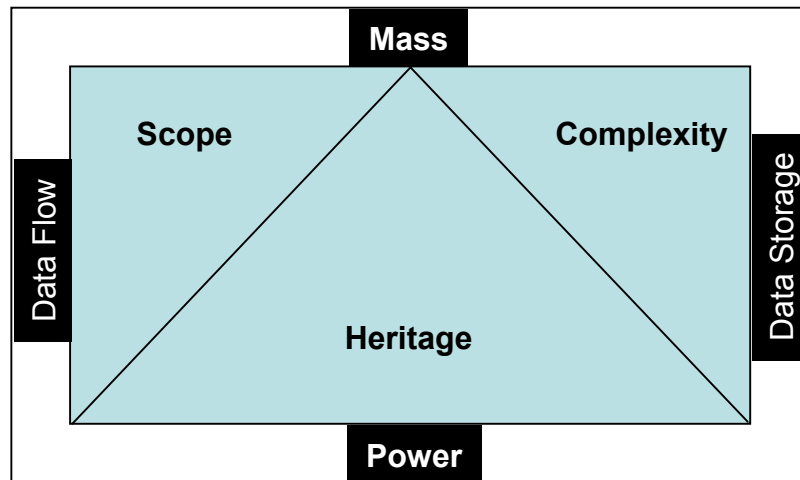
General Criteria

- Clean science requirements; not fuzzed up by caveats related to goals & desires
- Concise baseline & minimum mission success criteria
- Clear traceability from requirements through verification
- All requirements are verifiable and the verification plan draft is at an appropriate level of completion
- TBD's have clear rationale & justification and a plan & date for closure
- The lead systems engineer is the pivot point for managing goals & desires

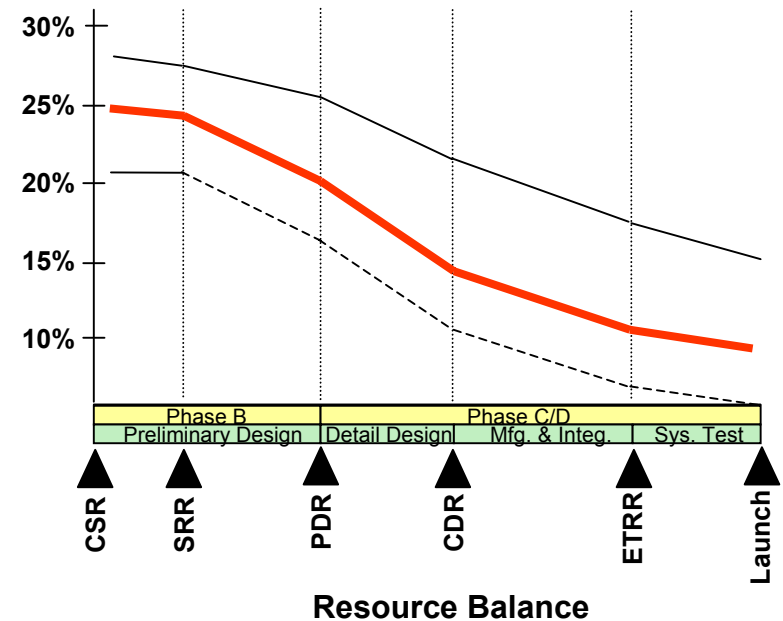


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Technical Approach



Technical Balance



Resource Balance

General Criteria

- Good (real) heritage; reasonable scope and complexity
- Resources consistent with scope & complexity
- Clear traceability of design choices with supporting trades & analyses
- Technical challenges under control
- No technical choke points – new/emerging technologies have solid backups
- Component selections confirmed by vendors
- TBD's have clear rationale & justification and a plan & date for closure
- Approach to redundancy & reliability consistent with Level 1 requirements



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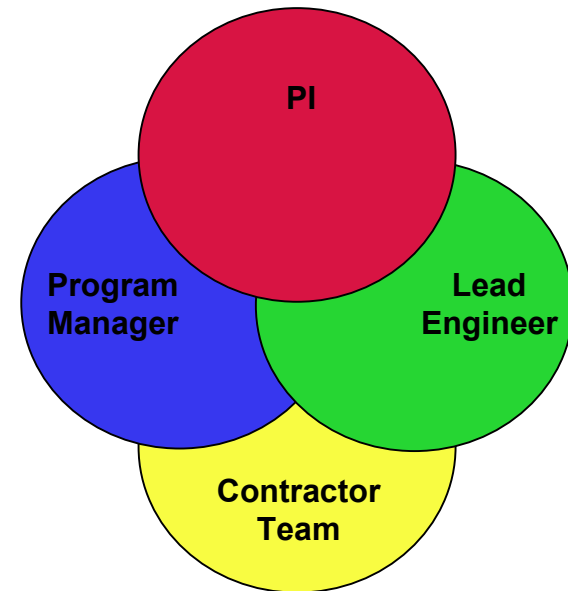
Management

Key Players Must:

- ✓ Communicate regularly
- ✓ Have experience or adequate backup
- ✓ Be committed full time
- ✓ Be cognizant of status & issues in the other 3 areas

General Criteria

- Org chart simple with clean lines of authority / responsibility
- Support organizations such as Mission Assurance are signed up
- Management tools are in place with evidence of effectiveness
- Management processes & reporting standards are established
- Consistency across the team in use the of tools & processes
- Adequate staffing; continuity of staffing
- Adequate subcontractor oversight / insight
- Institutional support & commitment
- Science team support & commitment





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Systems Engineering

Revealing Questions

- ❖ Requirements – Are they complete, traceable and verifiable? Have FP, I&T and the L/V signed up?
- ❖ Performance – Is it clear to the PI what the observatory will be able to do?
- ❖ Concept of Operations – Is it clear to the developers what the observatory has to do? Are operational modes defined and detailed? Are verification plans consistent?
- ❖ Science data – Are the downlink dataflow & bottlenecks well understood? Is data adequately protected?
- ❖ Heritage Assessment – Was it oversold? Is software development & test going to be the choke point?
- ❖ Instrument Accommodation – Do the instrument and spacecraft understand each other?
- ❖ Fault Protection Architecture – Does it address mission success or is it *way cool* ?
- ❖ Risks – Is everyone in agreement on the top risks? Is there a clear plan of risk management and retirement? Is there commitment to continuous risk assessment & mitigation?
- ❖ Trade Studies – Is the rationale, decision date and implementation criteria established for each trade?
- ❖ Verification Plan – Is it “test as you fly” ?
- ❖ TBD’s – Are the necessary analyses & tests getting done; are the actions overdue?
- ❖ Documentation – is the scope defined and the status of individual documents consistent with the phase of the project?
- ❖ Lessons Learned – Have they done the legwork? Is the project positioned to make history or repeat it?



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Systems Engineering cont.

General Criteria

- Lead Engineer is technically qualified and drives the program
- Lead Engineer “manages” goals & desires
- SE staffing is commensurate with the scope & complexity of the project
- SE tools & processes are complete and in use; SE staff is adequately trained



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Schedule

Origin of Problems

- ❖ Cost / Schedule Consistency – The funding profile needs to be consistent with the program milestones; i.e. slow ramp-up, peaks at PDR, CDR & I&T start, etc.
- ❖ Detail – Confidence in the implementation plan is proportional to the level of detail in the schedule. Delaying this effort can be very costly.
- ❖ Schedule Control – Many programs underestimate the importance of an experienced program control person. It's a huge mistake to consider this a justified cost savings.
- ❖ Critical Path & Long Lead Parts – This should be well thought out in Step 1 and well understood in Phase A. Programs often fail to consider the high risk areas such as software and C&DH.
- ❖ Margin (slack) Spread – Standard is 1 month per year during design & fab, 2 months per year during I&T, 1 week per month at the launch site. Reduction in margin or lumping it all at one point is cause for concern.
- ❖ Performance Measurement – A baseline and a way to measure performance against it are critical. Not knowing the status of the plan is the same as not having a plan.



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Cost

Origin of Problems

- ❖ Maxing Out in the Step 1 Proposal – Propose a reasonable risk profile with room for growth in Phase A.
- ❖ Cost Realism – Get cost detail early. Establish rationale and reserve to account for unknowns.
- ❖ Funding Profile – Can't count on heavy funding the first year. Consider profile limitations that may be more restrictive than the bottom line.
- ❖ WBS – Needs to be product oriented.
- ❖ Creeping Scope – The no. 1 job in phases A&B is to freeze requirements. TBD's equal liens.
- ❖ Reserves Spread – Reserves need to be available to solve problems in the development years (front-loaded profile). Money can be carried forward but not moved backward.
- ❖ Resiliency – Build resiliency against unanticipated Agency & Institutional cost hits.
- ❖ Subcontracts Management – Plan on being involved at the technical detail level.
- ❖ Late Descopes – Descopes are hardly ever worth as much as originally advertised. Descope triggers should be conservative (early).
- ❖ Performance Measurement – Tools should be up and running at program start.



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Top Ten Red Flags

-  **Excessive Scope / Complexity**
-  **Major Management “Issues”**
-  **Strained Resources – Mass, Power, People, Money, Time**
-  **Lack of Schedule Detail & Performance Measurement**
-  **Incomplete / Open Requirements**
-  **Cost & Schedule Reserves Not Spread Properly**
-  **Heritage Overestimated**
-  **Concept of Operations Not Defined Early**
-  **Risks Not Completely Defined / Adequately Managed**
-  **New Technology/Development Without Solid Backups**